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ABSTRACT

To provide students with the literacy strategies necessary to function successfully in a technologically supported society, teachers must realize how the multilayered grammars of computers continue to affect their definition of literacy. Computer-supported writing centers are an excellent site for teachers to share ideas about this changing definition. The arrangement, structural, formal, and physical conventions of computer screens are quite different from those of the printed page. These conventions affect the way individuals "see" text and construct meaning from written texts. Computers add several new grammars to what individuals must learn to become literate and affect those making the transition from page to screen text as follows: (1) politically, in the issue of equal opportunity and education; (2) economically, with respect to academic progress and career success; and (3) culturally, as they force individuals to become literate consumers and producers of both page and screen text. Commercial word processing packages with translation aids are now available to help individuals make this transition. However, preliminary research findings suggest that many people will never achieve equal fluency in both grammars. For example, results have shown that individuals read screen text more slowly and less accurately than they do printed text. These findings have strong implications for how teachers view layers of literacy instruction and how they identify and teach effective literacy strategies. (Figures and a bibliography are included.) (JD)

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Re-defining Literacy: The Multi-Layered Grammars of Computers

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It is 1987, and old news to note that computers have revolutionized the nature of written communication and, thus, the nature of literacy. We now take for granted the fact that increasing numbers of writers and readers are using computers to generate, manipulate, share, and store written text and graphics.

But it may be news to contend that the real work our profession must do with computers and literacy has just begun. If the most reluctant among us now accept that computers have had an impact on literacy, not even the most enthusiastic claim to know just what that impact has been or how we should deal with it in our teaching. In fact, we are just beginning to get an idea of how radically our definition of literacy changes when communication activities are mediated by computers. And until we get a grip on this new vision of computer-mediated literacy--a vision that accommodates reading, writing, and technology--our profession can hardly expect to be responsible in providing students with the strategies they need for functioning as successfully literate members of our technologically supported society.

Nowhere is there greater potential for achieving a degree of success in this exceedingly complex venture than there is in the numerous computer-supported writing centers that have been set up in schools and institutions across this country. These non-traditional communication environments are valuable to us because they are sites in which language production and learning occur

consistently within a technologically dependent context. Thus, they can serve as laboratories in which we can inform and update our notion of literacy as it is practiced in computer-supported communication environments. In these centers, we can begin to gather the data that will eventually allow us to construct a new vision of literacy as it has been, and continues to be, affected by computers.

To date, I should add, we have only begun this project and have had time only to identify the barest outlines of this new vision. Nor is rapid progress probable. Teachers and researchers trying to define the changing nature of literacy engage in a complex version of the old connect-the-dots game--one in which the players have never seen the entire picture they are trying to construct because it is still in the process of being formed. Often in this game, our perspective is limited; each one of us sees only one or two of the dots and must experiment with different methods of connecting them. But even the sketchy and incomplete representations we have been able to put together are exciting enough to warrant our continued and expanded attention.

We could progress more rapidly and effectively than we now are in our attempts to define literacy as it relates to computer-supported communication. To do so, we need to undertake a collective effort to share information about the dots each one of us

has already connected, to exchange educated guesses about the final form that the picture is taking. In this paper, I'd like to work toward that end, sharing some preliminary observations about the changing nature of literacy and showing a rough sketch of what I think literacy may now involve within the context of computer-supported communication environments.

Traditional Literacy

To understand how computers have altered the nature of literacy in the past decade, we need to begin with a broad baseline definition of that concept. And, if we agree for the purpose of this discussion to focus on print literacy rather than, for example, visual literacy or cinematic literacy, this definition need not be overly complex. Most of us would agree that literacy involves both reading and writing, and concerns the ways in which human beings make meaning from printed texts by interpreting content in light of their own purposes and needs.

We might also add to this definition that the responsibility for this process of constructing meaning cuts both ways in a literate culture, that it involves both the readers of text and the writers of text. Indeed, we know that literate individuals collaborate, in a sense, to make meaning, engaging in a unique kind of asynchronous, two-sided interpretation of personal experience,

even when one party never meets the other. Finally, we might add to the definition that literacy training involves teaching individuals the shared system of conventions associated with reading and writing.

I will focus on this last point about conventions because it gets at a crucial reason why computers affect literacy so immediately. By conventions, I mean those standard rules, variously referred to as "grammars" by Gumpert and Cathcart (1985) or as "formats" by Altheide (1985), which govern such things as arrangement, structure, form, and appearance of text. Armed with these rules, individuals can predict some things about the basic nature of texts that they read and write.

Let's look at the grammar of a page, for instance (see Figure 1). In Western cultures, a page is read by starting in the upper left-hand corner and proceeding to the lower right-hand corner in a line-by-line fashion. It is composed of a predictable set of structural components, consisting of letters that combine to form words, words that combine to form sentences, and sentences that add up to paragraphs, pages, sections, and chapters.

Insert Figure 1 about here.

Figure 1: Grammatical Conventions of a Page

Arrangement Conventions

front to back
top to bottom
left to right

Structural Conventions

letters --> words
sentences --> paragraphs
pages --> chapters

Formal Conventions

running heads
numbers
margins
footnotes
titles
subtitles

Physical Conventions

paper
bound in books
aspect ratio approximates 3:2
static structural unit of physical text

Pages have a number of formal conventions as well: running heads, numbers, standard margins on the sides and at the top and bottom, footnotes, titles, subtitles, or headings. Finally, pages have physical conventions: they are made primarily of paper and bound so that they can be quickly flipped through; their aspect ratio approximates 3 to 2. Within individual books, pages are a fixed size, arranged in a fixed order, and, hence, represent static structural units of a text that do not change from reading to reading. No matter how many times we read a copy of a book, a given piece of material will be on the same page in the same location; the page will be in the same order in the book. Pages, in this sense, are immutable. In fact, we use this particular characteristic of pages to locate information within the spatial context of a text. If we want to find a piece of information again in the future, we make a notation of its spatial location, referring to a particular page by number.

In important ways, these grammatical conventions that we learn during our literacy training allow us to "cope" (Strassman, 1983) with the world of print, to anticipate the characteristics that printed texts share and, thus, to use these texts efficiently.

In fact, these conventions are also important for a second reason. Scholars like Gumpert and Cathcart (1985), McLuhan (1967), and Ong (1982) claim that the conventions associated with specific media determine not only how we see text, but how we view the world as a whole and how we construct our reality. For evi-

dence of this claim, Ong cites, among other examples, Goody's (1977) research on indexes. His argument goes like this: until humans used print to represent their thinking in an essentially linear format on a collection of pages, they had no conception of retrieving a piece of information by identifying its spatial location. Thus, Ong suggests, when we invented indexes to help us find written information efficiently within such a context, we also discovered the essential concept of "indexing," the notion of cataloguing and retrieving information by recording its location in space. Because indexes have no equivalent in the natural world, until created the print medium and the convention of "index," we had no way of envisioning, or even thinking of, systematic information storage and retrieval.

For another example of this important concept, we can look to the film and TV. Recent work with these media suggests that humans observe media conventions like slow motion, split screens, objects revolving in space, that they internalize them, and that they later apply these conventions as "tools of thought" to problems unconnected with the medium itself. For instance, in a study that concentrated on the "zoom shot" as it has been defined by the movie and television industry, Salomon (1972) found that viewers who watched the technique of "zooming-in" on film, could internalize the convention and then apply it as a problem-solving strategy in other situations. The medium (television/video) and a convention of the medium (the zoom shot), in other words, provided subjects with a new way of constructing reality and meaning

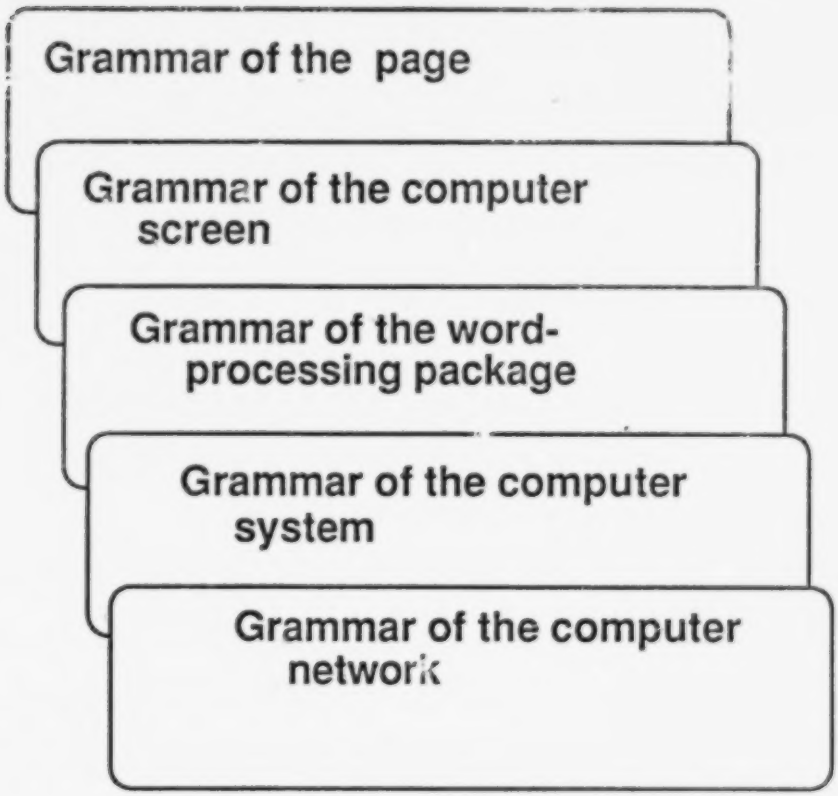
that they could not have acquired through observation of the natural world.

Literacy and Computers

Now, if we begin from this point, we can start to see how the use of computers as communication aids might affect literacy in two important ways. First, computers add several new grammars to the lists of things that individuals must learn before they become successfully literate in a computer-supported communication environment. Among them, we can posit grammars associated with computer keyboards and with computer screens, grammars connected with computer systems or with word-processing packages, grammars related to the use of computer networks or printers (see Figure 2). These new kinds of literacy are layered over the tasks of reading and writing, and they have a substantial impact on these activities. Second, computers may change the way we "see" text and construct meaning from written texts. Like the concepts of "indexing" and "zooming-in," some of the conventions associated with computers do not exist in the natural world, and these conventions may change the way in which we think about communication problems.

Insert Figure 2 about here.

Figure 2: The Multi-Layered Literacy of Computers


Grammar of the page
Grammar of the computer screen
Grammar of the word-processing package
Grammar of the computer system
Grammar of the computer network

To further explore both of these claims, we can look for a moment at the grammar of the computer screen. Although some conventions of the printed page carry over into, and indeed, are mimicked by the conventions of a computer screen, the major conventions of the two media are quite different (see figure 3). Pages are static structural units of a longer, spatially represented text; the text on a page does not change with time. Screens do not represent structural units of a text; rather, they are temporal windows on a virtual text. Virtual texts, unless they are translated into the print medium, exist only in the memories of the computer, the reader, or the writer.

Insert Figure 3 about here.

Because text on a screen is a temporal rather than structural unit, a reader of screen text lacks some of the spatial-contextual cues to which a reader of page text has access. A reader of a book can gauge its length in one glance and get an idea of format, organization, and arrangement by flipping through pages. In contrast, the reader of a virtual text on a collection of screens can see the whole text only in his or her mind, and must keep track of individual screens in the same way. Given this lack of spatial-contextual cues, movement through a virtual text is often considered more difficult than movement through a printed text, either slower when scrolling is done line by line,

Figure 3: Grammatical Conventions of a Screen

Arrangement Conventions

left to right
top to bottom
inside and out

Structural Conventions

pixels --> letters, words, etc.

Formal Conventions

cursors
fluid margins
windows
menus

Physical Conventions

glass or plastic
electronic
dynamic
temporal window on virtual text

or more erratic when one screen dissolves instantaneously into another at the touch of a key.

Screens also have different formal conventions than do pages. They are not numbered; their margins are fluid and easily modified by writers or readers; the aspect ratio of screens, at 4 to 2, mimics that of a television rather than most books. And screens have cursors, windows, and menu lines--characteristics not shared by pages.

Physical conventions also vary between the two media: unlike pages, screens are made of glass or plastic; unlike pages, screens must be activated by electric power sources. The text on a screen, we know, consists of phosphorescent pixels that are dynamic in their formation and in their display; text on a page, printed in ink, is static. On a screen, writers and readers can add and delete text, change margins and spacing, construct and re-construct text physically--text exists only in a fluid form. On a page, text is immutable.

The Effects of Layered Literacy

At this point, we have identified two very different sets of conventions that individuals must learn if they hope to function literately within computer-supported communication environments: conventions of the page and conventions of the screen. This

information suggests two concerns: How much of an impact do these different grammatical conventions have on individuals? Can people who have acquired literacy in the print medium acquire comparable computer-based literacy skills? In the remainder of this paper, I hope to demonstrate that this process of layering literacy, stacking in effect one grammar on top of another, has a profound impact--so profound, in fact, that individuals making the transition from page text to screen text must change the ways in which they read, write and make meaning from written text.

There is, of course, a constellation of highly charged political problems that surround our culture's transition from traditional print literacy to a multi-layered computer-based literacy, and at the heart of these problems lies the issue of equal opportunity and education. Not everyone is equally capable of acquiring facility with computer-based grammars. Given the relatively recent advent of computers, and our continuing reliance on hard-copy texts, individuals over the age of seven learn the literacy conventions of the page much earlier than they do those connected with the screen; they practice these grammars more frequently, and they are more comfortable with them. As one of my students put it the other day, most people speak computers as a second language. And if we carry this analogy even farther, we can predict that some level of interference will be present for these people as they supplement their print literacy with the literacy conventions associated with computers.

This situation becomes more disturbing when we realize how closely individuals' economic security, career success, or academic progress are tied to their ability to master computer-based grammars. Increasingly, employees, students, and teachers are required to learn computer systems quickly and under highly stressful situations. Students in many colleges, for example, are now expected to acquire computer-based literacy skills on their own in order to compete in their English composition classes. The teachers of these classes, who seldom feel responsible for matters of computer-based training, often neglect to provide their students adequate training and frequently lack understanding the complex nature of the literacy task that they are assigning as instructors. The same situation is true of executives in business or industry who see computers as quick fixes to office or production problems and require employees to read and write on sophisticated computer systems without adequate training.

In some ways, our culture has already tried to cope with this multi-layered literacy problem, with the fact that people must be, or become, literate consumers and producers of both page and screen text. For evidence, we can look at commercial word-processing packages which come equipped with translation aids that help readers and writers move back and forth easily between the grammar of the screen and that of the page (see Figure 4). At the bottom of every screen in these packages, you will see a ruler line or a status line. These lines give information both

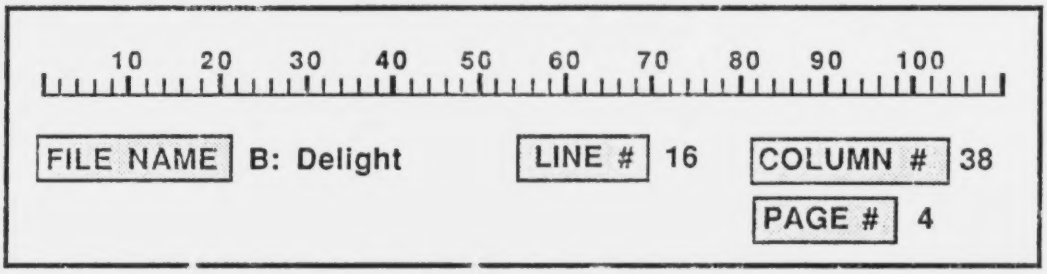
about the screen text and the translation of that text into hard copy. Typically, this line identifies the name of the virtual text currently being displayed on the screen and indicates how this text would appear if displayed on a traditional page, noting the spacing, page breaks, margins, and page numbers as they would appear in a print medium.

Insert Figure 4 about here.

Similar translation devices exist in the full-page, what-you-see-is-what-you-get (WYSIWYG) editors such as the Radius Full Page Display for the Macintosh computer. These devices, because they mimic the aspect ratio of a printed page, can display a portion of virtual text just as it would appear in the print medium. The purpose of the Radius Display, and similar machines, is to make work with a virtual text easier by electronically simulating some of the structural and formal conventions associated with a printed page.

But if these translation aids moderate the effects of multi-layered literacy, they do not eliminate them. Individuals still have to learn to cope with the conventions of the screen and the page, modifying reading and writing processes accordingly. And this recognition recalls my speculation that some people never

Figure 4: Ruler Line from a Word-Processing Package



achieve equal fluency for reading and writing with both grammars. Although we have only preliminary evidence to support this claim, it appears compelling.

Let's examine the case for reading first. We know from recent investigations, for example, that individuals read screen text more slowly (Gould and Grichowsky, 1984; Hansen et al, 1978), less accurately (Wright and Lickorish, 1983), and less effectively (Haas and Hayes, 1986) than they do text printed on a page. In these investigations, researchers noted that readers had more difficulty "getting a sense of the text" (1987) and found it harder to locate specific information (Haas and Hayes, 1986) on most computer screens than they did on a page. In addition, individuals proved less accurate in proofreading text on computer screens than they did on paper (Wright and Lickorish, 1983).

Although researchers have yet to determine why text on a computer screen is more difficult to read than text on a page, they suspect differences in variables such as resolution, font size, reading angle, color, may be responsible (Haas, 1987). Another explanation, however, may be equally as credible. Given the fact that the computer screen is a relatively new medium, we might posit that these studies show the effects of a "media generation gap" in Gumpert and Cathcart's terms (1985): individuals trained originally to deal with the grammatical conventions of a printed page, have not achieved a similar fluency in coping with the

grammar of a computer screen. As one of Chris Haas's subjects told her, "I use hard copy [text] because seeing it on the screen isn't really seeing it" (1987). We have pointed out, in addition, how this generation gap might become especially political in nature, when individuals trained for much of their lives to rely on hard copy, must learn, in a matter of days or weeks, to cope with screen copy, and must do so under highly trying and demanding circumstances tied to success in their career or progress in their academic program.

Writing, in a similar way, provides evidence of the various layers of literacy required in computer-supported writing environments and the problems involved in acquiring literacy skills during a period of transition. We can, for instance, examine the comments of this writer who continued to compose her drafts with paper and pencil, even after she had become basically competent in writing on a computer screen:

> I feel I can express myself better [with paper and pencil]....like I'm in control of the situation. Maybe I'm too far away with the computer. I mean the screen is <u>there</u>, and I am <u>here</u> (gestures). With paper and pencil, I'm touching the words. Also they [the words] look like <u>you</u> wrote them, not like the <u>machine</u> wrote them.

Another writer, trying to articulate why she had to translate her screen copy into hard-copy form so frequently, identified related difficulties:

> My words are in there [points to the computer], but not in the same way or in the same form as they are here [points to hard copy].... To me, writing changes magically somewhere between the screen and the printer. There is a transformation that occurs. I can write on the computer, and I can write on paper--but I need both to survive.

The comments of these two writers indicate their own conscious awareness of the multi-layered literacy they have to master in order to work effectively in a computer-supported communication environment. Specifically, these individuals face two challenges: first, they must learn the conventions of the computer screen, and, second, they must become facile in moving back and forth between the conventions of screen and page.

The Implications Of Multi-Layered Literacy

Before we can accurately assess the implications of these observations, we need once again to look at the speculative model of grammars that may be functioning within a computer-supported communication environment (see Figure 2). Each one of these grammars represents new layer of conventions that individuals must

learn if they hope to function successfully and literately within such an environment. Each one is equally as complex as the example of the computer screen that we just explored. And, as our use of computers and networks becomes more sophisticated in English composition classes, we will undoubtedly additional layers of literacy to this list. Some teachers of technical writing, for example, are already requiring that students acquire expertise in data-bases, graphics programs, spread sheets for use within classes.

For most of us, this notion of multi-layered literacy suggests a wide range of implications: for our definition of literacy, the ways in which we deal with reading and writing, or readers and writers; the manner in which we integrate computers into our English classes; the way in which we set up and operate computer-supported communication environments in support of English composition programs. Specifically, however, I would like to focus on two implications of this multi-layered literacy in the remainder of this paper.

The first implication has to do with teaching. Given the picture sketched within this chapter, it seems reasonable to assume that we might have to deal with layers literacy instruction, just as our students deal with layers of literacy demands. For some of these layers, I suspect, the task will be relatively easy. We

will probably, for instance, continue to teach reading and writing skills much as we now do: emphasizing multiple drafts, successive refinement of ideas, peer critiques and editing, conferences--regardless of whether writing is completed and shared on screen or in hard copy.

However, to address the succeeding layers of literacy that we have described in this paper, we will also have to begin identifying strategies for coping with the grammars that computers add to communication tasks. On the level of the screen grammar, for example, we may have to teach students new or different methods for reading texts on screen to supplement the instruction they have received in reading hard copy texts. We may have to show them, for instance, how to move about in a virtual text: how to use a search-and-replace commands to jump from section to section, how to re-format text for easier screen reading, or how to incorporate different kinds of intra-textual organizational markers for readers who view texts only on a screen.

Similarly, we're going to have to identify reading and writing strategies for helping students deal effectively with the conventions of word-processing packages, computer systems, and networks. The problem, of course, involves identifying and mastering these strategies ourselves, and this is another project that can be accomplished only by dint of a collective effort. Until teachers and writers begin cataloguing and sharing the literacy strategies that they have used in computer-supported writing

environments, and testing them on different populations, our efforts will remain scattered and unsystematic.

The second implication I have chosen to focus on relates to this effort of identifying and teaching effective literacy strategies. The more I work with students in computer-supported communication environments, the less adequate I feel to undertake this task alone. In fact, I suspect that our generation, raised as we have been on the print medium, may not be capable of generating some of the more creative strategies for coping with the conventions of computer screens, computer systems, or computer networks. Our conceptual vision in these areas may be limited by the media generation to which we belong and the pencil-and-paper strategies with which we have struggled for so long (Selfe and Wahlstrom, 1986). And in this sense, we may have to turn our own students--observing the literacy strategies they develop on their own for coping within computer-supported communication environments.

For evidence of my suspicion, I can describe the experience of teaching computer-supported writing courses at Michigan Tech. As part of these classes, which are frequently taught in the Center for Computer-Assisted Language Instruction (CCLI), students are frequently required to write their journals or papers on our local area computer network, exchange drafts of their peers by posting them on a computerized bulletin board, confer with a teacher through an electronic mailbox, or participate in an electronic conference.

In this computer-supported writing facility, some faculty members in our Humanities Department prefer to run "paperless" classrooms--storing all handouts and lecture notes on the computer and asking students to hand in their writing assignments on-line. In these classes, most reading and writing is done via the medium of the computer screen rather than the printed page. Soon after we began this practice, faculty within our program began to notice that the writing assignments students did for the computer screen were different in both form and content than the writing assignments they produced for the print medium. (1)

One of the first characteristics that became evident, for instance, was that students had learned on their own initiative to write text to be read on a screen rather than a page, thus handicapping readers who print the text out in a print medium. In their papers, for example, students incorporate flashing notes and headings, boldfaced type, and highlighted segments of text (light background color and dark characters rather than the usual dark background and light characters)--all conventions that do not print legibly in hard copy. In addition, students use formatting conventions that are screen-based rather than page-based, often using shorter paragraphs that can be viewed on a single screen, breaking the text into screen-sized chunks so that readers can more efficiently use the "page-up" and "page-down" keys as they read, and centering text within the window of the page.

A second, and perhaps more unusual characteristic of these texts involves the use of color as a visual cue to underlying logical content and structure. Students, for example, use three different colors to signify primary, secondary, and tertiary headings; use two different colors to "paint" contrasting arguments contained within a single paragraph; use color coding to identify thesis or topic statements and the evidence that supports these central ideas. These "painting" strategies are important because they go beyond mere decoration of a text to represent a visual revelation of logical structures. As Steve Bernhardt (1986, p. 66) notes, such visual cues heighten readers' "awareness of categories and divisions, changing the ways people conceive classificatory divisions." Bernhardt also maintains that teachers of writing should encourage students to "experiment with visual features of written texts" so that they can "increase their ability to understand and use hierarchical and classificatory arguments."

What has become obvious to the teachers within our program is that the writers in our classes who compose their texts for reading on computer screens have invented and exploited a new set of literacy skills that their teachers never imagined. Using different fonts, font sizes, symbols, highlighting, and graphic elements, they have not only adjusted their writing to the conventions of the screen and the computer, but actually re-conceptualized the content of their assignments in terms of these conventions. In this case, it seems possible that the grammar of

the computer, the word-processing package, and the computer changed the way in which writers think and express thought.

These insights, of course, make us wonder whether there aren't other computer conventions that may similarly affect our world view. Whether, for example, the convention of the virtual text as it exists in a computer and on screen will encourage us to develop new ways of handling large texts in our mind's eye, leading us to a new conceptual ground that exists somewhere between the print literacy we know now and a literacy of the virtual text that we have yet to define; whether students who learn the concept of windowing in a word-processing package, then apply this literacy convention in new creative ways to other communication situations; or whether writers who learn to re-format screen text will somehow see printed text in a different way. These conceptual shifts, as this paper noted earlier, may occur differently depending on our media generation.

In other words, our work is cut out for us. Our profession will have to work diligently in the next few years to identify and explore the changing nature of literacy within a computer-supported writing environment, and consider the implications of these changes for our teaching. And we are going to have to do this job even as the computer industry continues its explosive growth.

I continue to think that computer-supported writing labs and classrooms may be the best site for this work because they offer us opportunities for both research and teaching. In these facilities, we can observe the changing literacy demands on our students, gather evidence of the impact of these demands, develop teaching strategies that will help our students cope with these demands, and then test these teaching strategies on a variety of populations. And that job will be exciting and creative news for us all.

END NOTE

(1) I owe several intellectual debts that I will attempt to acknowledge here. First, I have to thank Billie Wahlstrom for so graciously sharing with me the electronic journal writes from her Mass Communication class and for helping me make some sense of these "new" texts. I used these journal entries to corroborate the observations I made in my own computer-supported writing classes.

Second, I thank Marilyn Cooper. Over a memorable dinner, she helped me to understand many important differences between grammars of the page and of the screen. I was so excited that I couldn't eat.

The three of us, I might suggest, are navigating by triangulation as we attempt to connect the dots of computer literacy.

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